



Thermoplastic/CNT Yarn Filaments

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Objectives

Develop continuous CNT yarn/engineering polymer filament for FDM based 3-D printers

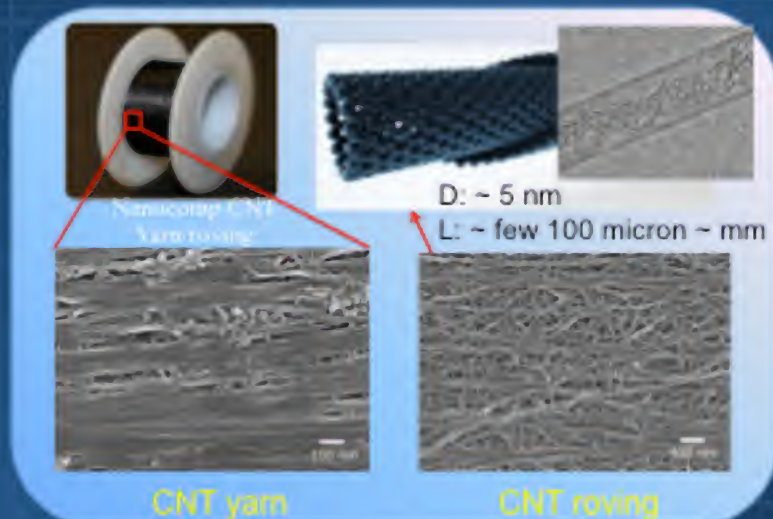
- Enhanced mechanical properties – engineering polymers and continuous CNT yarn
- Improve interfacial adhesion – solution infiltration
- Sustain flexibility during 3-D printing – enable 90 and 180 degree turns



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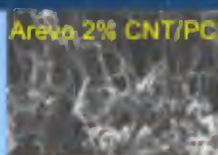


CNT yarn

CNT roving

State-of-the art nanomaterial feedstocks

- Arevo Labs
 - 2% CNT/polycarbonate
 - 1% chopped carbon fiber/PEI
 - 10% chopped carbon fiber/PEEK



- Grafioid Inc.- Altamat Inc.
 - MesoGraf based graphene powder and filament

- Mark Forged – Mark one carbon fiber 3D printer
 - Continuous carbon fiber/nylon

- 3DX Tech
 - CNT/ABS feedstock

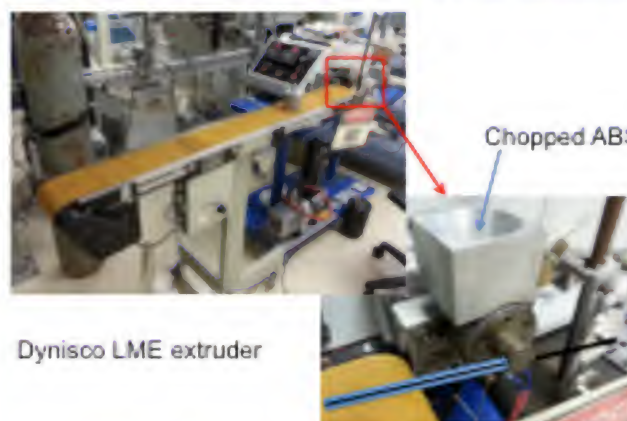


- Masood et al., Mater. Design 32, 3448 (2011).
 - Iron and copper/ABS filament



NASA LaRC Polymer Processing Capabilities

Thermoplastic extruder for 3D printer feedstock



Dynisco LME extruder



Extruded ABS/CNT yarn

Automated resistive heating assisted polymer coater



CNT yarn

Polymer solution bath

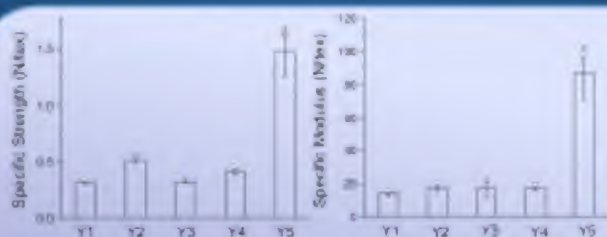
Sonicator

Pick-Up motor

Power supply



Processed Feedstocks and Properties



Y1: Untreated CNT yarn, tex: 1.2 g/km
 Y2: acetone treated CNT yarn, tex: 1.4 g/km
 Y3: unspun CNT roving, tex: 1.1 g/km
 Y4: spun CNT roving, tex: 0.9 g/km
 Y5: high tex CNT yarn, tex: 34.8 g/km



Ultem/CNT yarn (63 : 37 wt. %)

ABS/high tex CNT yarn



Ultem/high tex CNT yarns